



Next generation gamma/neutron detectors for planetary science

Radiation Monitoring Device, Inc.

PI: James Christian, Proposal#: NNX13CM33C

OBJECTIVES

The goal of the Phase-II program is to develop a gamma/neutron detector prototype using wide-band-gap AlGaAs-based SSPM coupled to emerging scintillation materials that provide dual gamma/neutron discrimination, compact size, better noise performance, low power consumption, radiation hardness, and good energy resolution. The major technical objectives achieved in this program are:

- Optimize process recipe for AlGaAs GPD and SSPM fabrication
- Provide an AlGaAs GPD with high sensitivity in blue/UV range.
- Provide advanced scintillation detector prototype.



ACCOMPLISHMENTS

NOTABLE DELIVERABLES PROVIDED

- Technical Reports
- Two publications:
 - Min Ren, Yaojia Chen, Wenlu Sun, X. J. Chen, E. B. Johnson, J. F. Christian, and J. C. Campbell, "Linear- and Geiger-Mode Characteristics of Al_{0.8}Ga_{0.2}As Avalanche Photodiodes," Photonics Technology Letters, IEEE, vol. 26, pp. 2480-2483, 2014.
 - X. J. Chen, M. Ren, Y. Chen, E. B. Johnson, J. C. Campbell, and J. F. Christian, "Characterization of Al_{0.8}Ga_{0.2}As Geiger Photodiodes," in SPIE Optics and Photonics 2015, San Diego, CA, 2015. XJCs
- Prototype detector element (Geiger Photodiode)
- Si-SSPM-based scintillation detector.

KEY MILESTONES MET

- Optimized fabrication recipe for AlGaAs diodes with low dark currents.
- Design and fabrication process for optimized quantum efficiency from AlGaAs diode.
- Demonstration of Geiger mode operation.
- Demonstration of GPD with low dark count rates and high quantum efficiency from 350 nm to 450 nm.
- Demonstration of high-energy resolution with advanced scintillation materials (e.g. CLYC, CeBr₃).

FUTURE PLANNED DEVELOPMENTS

PLANNED POST-PHASE-2 PARTNERS

- NASA
- DNDO
- Canberra
- ThermoFisher

PLANNED/POSSIBLE MISSION INFUSION

- A silicon-based SSPM +DPA scint. detector for the RHEME (Radiation Hardened Electronic Memory Experiment). A joint NASA Johnson and AFRL endeavor.
- Si-based SSPMs for LunaMap (Mission submitted to NASA AO NNH14ZDA001N-SIMPLEx)
- Si-based SSPMs + SrI₂:Eu for SIRI (Strontium Iodide Spectroscopy Instrumentation)

PLANNED/POSSIBLE COMMERCIALIZATION

- RMD commercializing Scintillation Detector modules with the following detector options:
 - Photomultiplier tube
 - Si-SSPM
- Future WBG SSPM option

CONTRACT (CENTER)

NNX13CCM33C (Marshall Space Flight Center)

SOLICITATION-PHASE

SBIR/STTR 2011-1, Phase-2

SUBTOPIC: S1.09, In-situ Sensors and Sensor Systems for Lunar and Planetary Science.

TA: Sensors

TRL

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